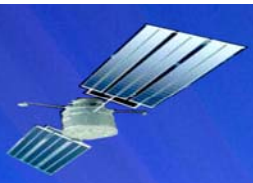

SDI

SpectraDynamics, Inc.

SpectraDynamics, Inc.

SpectraDynamics, Inc. (SDI) was founded in 1994 as a company specializing in high performance time and frequency distribution systems. The company had close ties to the National Institute of Standards and Technology and therefore became involved in the research and development of new technology making use of the state-of-the-art technology to provide the low noise, ultra-stable electronics to support atomic frequency and time standards.

SpectraDynamics has developed novel frequency synthesis architectures and time and frequency measurement methods, which it developed into product lines. Featured items are the NMS-1, Noise Measurement System and the RFPWR, a handheld power meter. Excellent performance, reliability and affordability is what best describes our products.

Our ***main product lines*** are Time and Frequency Distribution, Low Noise Frequency References, Low Noise Frequency Synthesizers, and Noise Measurement Systems.

In addition to the standard products we also provide ***custom-engineered solutions***. If you have any questions concerning a particular application, please do not hesitate to contact us.

Our customers include National Time and Frequency Laboratories, Government Agencies, Universities, Department of Defense Contractors and Telecommunication Companies.

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CLOCK SIGNAL DISTRIBUTION AMPLIFIER, CSDA-1

DESCRIPTION

The CSDA-1 is a high performance clock signal distribution and isolation amplifier. The device is used to provide distribution of 1 PPS signals, 5 MHz signals and 10 MHz signals. The CSDA-1 contains a pulse distribution module with one input and five buffered outputs that can drive a 50-ohm cable. The second module is a 5 MHz distribution amplifier with one input and five outputs. The third module provides five buffered and isolated 10 MHz signals that are obtained by doubling the 5 MHz input signal. The channel-to-channel isolation in the RF distribution modules is typically 125 dB and reverse isolation is typically greater than 135 dB. The phase noise of the modules is exceptionally low, typically –150 dBc/Hz @ Fourier frequency of 1 Hz and –172 dBc/Hz @ Fourier frequency greater than 10 kHz. Both the input and output are matched to 50 ohms to obtain better than 25 dB return loss. All RF outputs are AC coupled and the grounds are DC isolated to reduce the effect of ground loops.

FEATURES

- Distributes:
  1 PPS, 5 MHz & 10 MHz signals
- High Isolation
- Low phase noise
- Very good stability
- Signal fault alarm
- Battery backup available

APPLICATIONS

- Clock signal applications
- Atomic frequency standards
- Atomic time scales
- Laboratory frequency distribution
- Reference frequency distribution
- Time synchronization

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SPECIFICATIONS

Pulse Distribution Module - The rise and fall times were tested with a TTL input signal at 100 kHz.

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Rise time	10 - 90 %	-	3	4	ns
Fall time	10 - 90 %	-	3	4	ns
Propagation delay	50 ohm load	-	10	12	ns
Differential delay	channel - channel		200	500	ps
Impedance	input output		50 10		Ohms
Input high level Input low level	input signal into 50 ohm load input signal into 50 ohm load	2 -0.7	- -	5 0.8	V
Output high level Output low level	50 ohm load 50 ohm load	2 -	2.4 0.4	- 0.5	V
Temperature-delay coefficient	0 - 50 ºC 25 - 35 ºC		3 3	5	ps/ºC

5 MHz Module

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Max. input level	1 dB compression	16	17		dBm
Bandwidth	+/- 1 dB	1 - 20			MHz
Gain	@ 5 MHz			+/- 0.5	dB
Impedance	input output		50 50		Ohms
Return loss	input (S11)) 5 MHz output (S22)) 5 MHz		-35 -25	-25 -25	dB
Distortion	+13 dBm +16 dBm		-48 -40	-45	dBc
Isolation	output to output output to input	120 130	125 135		dB
Phase noise	1 Hz 10 Hz 100 Hz >10 kHz		-150 -160 -170 -170	-147 -157 -167 -169	dBc/Hz
Temperature-delay coefficient	0 - 50 ºC 25 - 35 ºC		3 1.5	5	ps/ºC

10 MHz Module

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Output level	5 MHz input +13 dBm	12	13	15	dBm
Bandwidth	+/- 1 dB	500 kHz	600 kHz	1 MHz	MHz
Gain	@ 5 MHz		0	+/- 0.5	dB
Impedance	output		50		Ohms
Return loss	output (S22) 10 MHz		-25	-20	dB
Distortion	+13 dBm		-48	-45	dBc
Isolation	output to output	120	126		dB
Phase noise	1 Hz 10 Hz 100 Hz >10 kHz		-142 -149 -159 -164	-140 -147 -155 -160	dBc/Hz
Temperature-delay coefficient	0 - 50 ºC 25 - 35 ºC		10 5		ps/ºC

DISTRIBUTION AMPLIFIER, DA-100

DESCRIPTION

The DA-100 is a wide band general-purpose isolation amplifier designed to distribute frequencies from 0.3 MHz to 200 MHz. The DA-100 is the low cost solution for reference frequency distribution. The DA-100 offers 70 dB of channel-to-channel isolation and 90 dB of reverse isolation. The exceptionally low phase-noise of -156 dBc/Hz at 10 Hz, and –163 dBc/Hz for the noise floor ensures that your reference signals are not degraded. The input and outputs have low VSWR to minimize environmental effects on frequency distribution through long transmission lines. The inputs are chassis grounded and all outputs are DC isolated. The standard unit has two inputs and twenty-four outputs.

FEATURES

- 1 - 100 MHz, 1 dB BW
- 2 inputs, 24 outputs
- Unity gain
- Low VSWR
- High isolation: 70 dB
- Low phase noise: -156 dBc/Hz @ 10 Hz
  -163 dBc/Hz @ 10 kHz
- Low distortion: -40 dBc

APPLICATIONS

- Atomic frequency standards
- Atomic time scales
- Laboratory frequency distribution
- Reference frequency distribution

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SPECIFICATIONS

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Input power		-	-	+15	dBm
Bandwidth	+/- 1 dB +/- 3 dB	1 - 100 0.3 - 200	1 - 100 0.3 - 200	-	MHz MHz
Gain	@ 5 MHz	-	0	+/- 1	dB
Input VSWR	1-100 MHz	-	1.3	-	-
Output VSWR	1-100 MHz	-	1.4	-	-
Impedance	input output	-	50 50	- -	Ohms
Distortion	+10 dBm +13 dBm	-	-45 -40	- -	dBc
5, 10 MHz isolation	output to output output to input	70 90	73 95	- -	dB
100 MHz isolation	output to output output to input	45 80	48 85	- -	dB
Phase noise	10 Hz 100 Hz 10 kHz	- - -	-156 -162 -163	-153 -159 -160	dBc/Hz

All tests done at 5 MHz and +13 dBm input unless otherwise specified.

HIGH PERFORMANCE DISTRIBUTION AMPLIFIER, HPDA-15RM

DESCRIPTION

The HPDA-15RM distribution amplifier exceeds the performance required to distribute state-of-the-art atomic frequency standards. The HPDA-15RM offers 126 dB of channel-to-channel isolation and 135 dB of reverse isolation. The exceptionally low phase noise -150 dBc/Hz at 1 Hz implies a short term frequency stability of 1 part in 10^{14} at 1 s. The HPDA-15RM exhibits a low temperature coefficient of phase of 3 ps/ºC throughout the operating range. The input and outputs have a low VSWR to minimize environmental effects on frequency distribution through long transmission lines. The HPDA-15RM is an enhanced version of the NIST high isolation distribution amplifier.

FEATURES

- 1-20 MHz
- Unity gain
- Low VSWR
- High isolation: 126 dB
- High output: +17 dBm
- Low phase noise: -150 dBc/Hz @ 1 Hz
  -172 dBc/Hz @ 10 kHz
- Low distortion: -48 dBc
- Low temperature coefficient: 1.5 ps/ºC

APPLICATIONS

- Atomic frequency standards
- Atomic time scales
- Laboratory frequency distribution
- Reference frequency distribution

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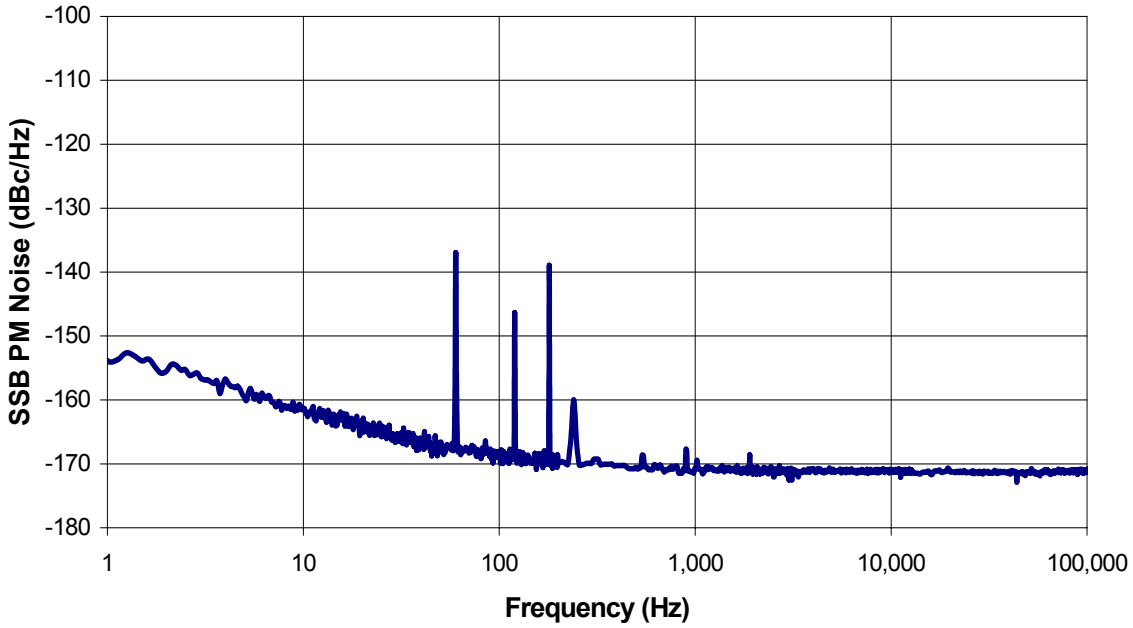
HPDA-15RM Phase Noise Plot



Note: The 60 Hz and related harmonics on the phase noise plot are generated by the measurement system.

SPECIFICATIONS

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Input level	1 dB compression	17	18	-	dBm
Bandwidth	+/- 1 dB	1 - 20	-	-	MHz
Gain	@ 5 MHz	-	-	+/- 0.5	dB
Impedance	input output	- -	50 50	- -	Ohms
Return loss	input (S11) 5 MHz output (S22) 5 MHz	- -	-35 -25	-25 -25	dB
Distortion	+13 dBm +17 dBm	- -	-48 -40	-43	dBc
Isolation	output to output output to input	120 120	126 135	- -	dB
Phase noise	1 Hz 10 Hz 1 kHz 10 kHz	- - - -	-150 -160 -171 -172	-147 -157 -169 -170	dBc/Hz
Temperature-delay coefficient	0 - 50 ºC 25 - 35 ºC	- -	3 1.5	5 -	ps/ºC

All tests done at 5 MHz and +13 dBm input unless otherwise specified

HPDA-15 OPTIONS

HPDA-15RM-A

This option provides an amplifier module with one input and five outputs in a 1U high 19" rack-mount enclosure. The front panel contains an AC POWER LED and a signal MONITOR LED. The back panel contains one SMA input connector, five SMA output connectors and a power entry module. The power requirements are 110/220 VAC.

HPDA-15RM-B

This option provides three amplifier modules with one input and five outputs each in a 1U high 19" rack-mount enclosure. The front panel contains an AC POWER LED and three signal MONITOR LEDs. The back panel contains three SMA input connectors, fifteen SMA output connectors and a power entry module. The power requirements are 110/220 VAC.

HPDA-15RM-C

This option provides three amplifier modules with one input and five outputs each in a 1U high 19" rack-mount enclosure. The front panel contains an AC POWER LED, a DC POWER LED and three signal MONITOR LEDs. The back panel contains three SMA input connectors, fifteen SMA output connectors, a DC and AC power entry connectors. This unit includes a battery backup module that allows the instrument to be powered by a DC power source in case of loss of the main AC power. The power requirements for this model are 110/220 VAC and +24 VDC, 2A.

HPDA-15RM-E

This option provides three amplifier modules with one input and five outputs each in a 1U high 19" rack-mount enclosure. This model contains a FS020-5, 5 MHz doubler option. The 5 to 10 MHz Frequency Doubler multiplies the signal coming into the third SMA input connector located on the front panel. The corresponding five outputs of the third module are therefore 10 MHz outputs. The front panel contains a AC POWER LED, three signal MONITOR LEDs, three SMA input connectors, and fifteen SMA output connectors. The back panel contains an AC power entry module. The power requirements are 110/220 VAC.

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HIGH PERFORMANCE DISTRIBUTION AMPLIFIER, HPDA-100

DESCRIPTION

The HPDA-100RM is a high performance distribution and isolation amplifier. Each distribution amplifier module has five unity gain outputs with 100 dB of channel-to-channel isolation and 110 dB of reverse isolation. All outputs are AC-coupled and the grounds are DC-isolated to reduce the effects of ground loops. The input and outputs have a low VSWR to minimize environmental effects on frequency distribution through long transmission lines. The HPDA-100RM is available in a 1 U high 19" rack-mount enclosure.

FEATURES

- 80-120 MHz
- Unity gain
- Return loss -25 dB
- High isolation: 100 dB
- Low phase noise: -158 dBc/Hz @ 10 Hz
  -172 dBc/Hz @ 10 kHz
- Low distortion: -45 dBc
- High output: +15 dBm

APPLICATIONS

- Atomic frequency standards
- Instrumentation
- Reference frequency distribution
- Time scales

HIGH PERFORMANCE DISTRIBUTION AMPLIFIER, HPDA-100

SPECIFICATIONS

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Input level	1 dB compression	15	16	-	dBm
Bandwidth	+/- 1 dB	80 - 120	-	-	MHz
Gain	@ 100 MHz	-	0	+/- 0.5	dB
Impedance	input output	- -	50 50	- -	Ohms
Return loss	input (S11) 100 MHz output (S22) 100 MHz	- -	-22 -30	-20 -25	dB
Distortion	+13 dBm	-	-45	-40	dBc
Isolation	output to output output to input	95 105	100 110	- -	dB
Phase noise	10 Hz 100 Hz 1 kHz 10 kHz	- - - -	-158 -165 -171 -174	-155 -162 -168 -171	dBc/Hz

All tests done at 100 MHz and +13 dBm input unless otherwise specified.

HPDA-100 OPTIONS

HPDA-100RM-A

This option provides an amplifier module with one input and five outputs in a 1U high 19" rack-mount enclosure. The front panel contains an AC POWER LED and a signal MONITOR LED. The back panel contains one SMA input connector, five SMA output connectors and a power entry module. The power requirements are 110/220 VAC.

HPDA-100RM-B

This option provides three amplifier modules with one input and five outputs each in a 1U high 19" rack-mount enclosure. The front panel contains an AC POWER LED and three signal MONITOR LEDs. The back panel contains three SMA input connectors, fifteen SMA output connectors and a power entry module. The power requirements are 110/220 VAC

HPDA-100RM-C

This option provides three amplifier modules with one input and five outputs each in a 1U high 19" rack-mount enclosure. The front panel contains an AC POWER LED, a DC POWER LED and three signal MONITOR LEDs. The back panel contains three SMA input connectors, fifteen SMA output connectors, a DC and AC power entry connectors. This unit includes a battery backup module that allows the instrument to be powered by a DC power source in case of loss of the main AC power. The power requirements for this model are 110/220 VAC and +24 VDC, 2A.

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PULSE DISTRIBUTION AMPLIFIER, PD-5

FEATURES

- 1 input, 5 outputs
- 10 ns propagation delay
- 50 ohm output: 2 Vp-p
- Low temperature coefficient: 3 ps/ºC
- Matched channel delays

APPLICATIONS

- 1 PPS distribution
- Reference clock distribution
- Time synchronization

DESCRIPTION

The PD-5 is a TTL pulse distribution amplifier. The outputs are designed to drive low impedance loads and long 50 or 75 Ω cables. The propagation delay through the amplifier is typically 10 ns. The channel-to-channel delay differences are less than 1 ns. The small propagation delay characteristics and low temperature coefficient of delay are essential for the distribution of high quality timing signals. The unit operates on 110/220 VAC.

PD OPTIONS

PD-5, This amplifier model takes one input and provides five outputs. This model is available in a 2U high, half rack mount enclosure, 3.5" X 8.4" X 12".

PD-5RM-B, This amplifier model takes one input and provides five outputs. This model is available in a 1U high, 19" full rack mount enclosure.

PD-10RM-B, This amplifier model takes one input and provides ten outputs. This model is available in a 1U high, 19" full rack mount enclosure. A battery back up module for uninterrupted operation may be ordered as an option.

SPECIFICATIONS

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Rise time	10 - 90 %	-	3	4	ns
Fall time	10 - 90 %	-	3	4	ns
Propagation delay	50 ohm load	-	10	12	ns
Differential delay	channel - channel	-	200	500	ps
Impedance	input Output	-	1k 10	-	Ohms
Input high level Input low level	input signal into 50 ohm load input signal into 50 ohm load	2 -0.7	- -	5 0.8	V
Output high level Output low level	50 ohm load 50 ohm load	2 -	2.4 0.4	- 0.5	V
Temperature-delay coefficient	0 - 50 ºC 25 - 35 ºC	- -	3 3	5 -	ps/ºC

VARIABLE GAIN AMPLIFIER, VG-100

FEATURES

- 3 dB BW, 1-100 MHz
- Variable gain
- Low distortion: -40 dBc @ +13 dBm
- Low phase noise: -161 dBc/Hz @ 10 Hz
  -171 dBc/Hz @ 10 kHz

APPLICATIONS

- Test and measurements
- General purpose amplification
- Low noise amplification

DESCRIPTION

The VG-100 is a variable gain amplifier with a minimum gain of +6 dB. Four gain switches on the front panel provide additional gain in steps of +1 dB, +2 dB, +4 dB and +8 dB. The VG-100 features low phase noise and a 100 MHz bandwidth. The input and output of the amplifier are AC coupled. Signal input and output connectors are SMA. The VG-100 comes in a 2U half-rack enclosure and operates on 110/220 VAC.

SPECIFICATIONS

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Input level		-	-	+8	dBm
Bandwidth	- 3 dB	1 - 100	1 - 100	-	MHz
Gain	@ 5 MHz	+6	-	+21	dB
Impedance	input output	- -	50 50	- -	Ohms
Return loss	input (S11) 5 MHz output (S22) 5 MHz	- -	-35 -25	-25 -25	dB
Distortion	+13 dBm +15 dBm	- -	-40 -35	- -	dBc
Phase noise	10 Hz 1 kHz 10 kHz	- - -	-161 -171 -172	-158 -169 -170	dBc/Hz

All tests done at 100 MHz and +13 dBm input unless otherwise specified.

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DISTRIBUTION AMPLIFIER, DS-100

FEATURES

- Unity gain
- Low VSWR
- High isolation: 70 dB @ 5 MHz
  50 dB @ 100 MHz
- Low phase noise: -150 dBc/Hz @ 10 Hz
  -170 dBc/Hz @ 10 kHz
- Low distortion: - 40 dBc
- Max. output: + 15 dBm

APPLICATIONS

- Frequency synthesis chains
- Reference frequency distribution

DESCRIPTION

The DS-100 is an isolation amplifier designed to distribute signals with frequencies from 1 to 200 MHz. A X2 or X4 multiplier option is available to provide auxiliary outputs at the multiplied frequency. The DS-100 offers 50 dB of channel-to-channel isolation and 60 dB of reverse isolation at 100 MHz. The exceptionally low phase noise -150 dBc/Hz at 10 Hz and –170 dBc/Hz for the noise floor ensures that your reference frequencies are not degraded. The input and outputs have a low VSWR to minimize environmental effects on frequency distribution through long transmission lines. The standard unit provides four output channels.

SPECIFICATIONS

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Input level		-	+13	+15	dBm
Bandwidth	+/- 1 dB +/- 3 dB	5 - 120 1 - 200	5 - 120 1 - 200	- -	MHz MHz
Gain	@ 100 MHz	-	0	+/- 1	dB
Input VSWR	1-100 MHz	-	1.3	-	-
Output VSWR	1-100 MHz	-	1.4	-	-
Impedance	input output	- -	50 50	- -	Ohms
Distortion	+10 dBm +13 dBm	- -	-40 -40	- -	dBc
100 MHz isolation	output to output output to input	50 60	50 60	- -	dB
Phase noise	10 Hz 100 Hz 10 kHz	- - -	-150 -160 -170	-147 -157 -167	dBc/Hz

All tests done at 100 MHz and +13 dBm input unless otherwise specified.

FIXED GAIN AMPLIFIER, FG-100

FEATURES

- Variable gain
- Low phase noise: -160 dBc/Hz @ 10 Hz
  -174 dBc/Hz @ 10 kHz
- Low distortion: -40 dBc @ +13 dBm
- 3 dB BW 1-200 MHz

APPLICATIONS

- Amplifications of low phase noise signals
- Phase noise measurements
- Transmission line loss compensation

DESCRIPTION

The FG-100 is a general purpose fixed gain amplifier with a gain of +10 dB. For custom applications the gain of the amplifier can be specified at the time of ordering. The unit features low phase noise and a 200 MHz bandwidth. The input and output of the amplifier are AC coupled. Signal input and output connectors are SMA. The FG-100 comes in a milled aluminum enclosure 0.85" X 1.5" X 2.0".

SPECIFICATIONS

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Input level		-	-	+4	dBm
Bandwidth	- 3 dB	1 - 200	-	-	MHz
Gain	@ 5 MHz	-	+10	-	dB
Impedance	input output	- -	50 50	- -	Ohms
Return loss	input (S11) 5MHz output (S22) 5MHz	- -	-35 -25	-25 -25	dB
Distortion	+13 dBm +15 dBm	- -	-40 -35	- -	dBc
Phase noise	10 Hz 1 kHz 10 kHz	- - -	-160 -174 -175	-158 -172 -173	dBc/Hz

All tests done at 5 MHz and +13 dBm output unless otherwise specified.

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HIGH PERFORMANCE DISTRIBUTION AMPLIFIER
HPDA-5 Modules

FEATURES

- 1-20 MHz
- Unity gain
- Low VSWR
- High isolation: 126 dB
- High output: +17 dBm
- Low phase noise: -150 dBc/Hz @ 1 Hz
  -172 dBc/Hz @ 10 kHz
- Low distortion: -48 dBc
- Low temperature coefficient: 1.5 ps/ºC

APPLICATIONS

- Atomic frequency standards
- Atomic time scales
- Reference frequency distribution

DESCRIPTION

The HPDA-5 distribution amplifier exceeds the performance required to distribute state-of-the-art atomic frequency standards. The HPDA-5 offers 126 dB of channel to channel isolation and 135 dB of reverse isolation. The exceptionally low phase-noise -150 dBc/Hz at 1 Hz implies a short term frequency stability of 1 part in 10^{14} at 1 s. The HPDA-5 exhibits a low temperature coefficient of phase of 3 ps/ºC throughout the operating range. The input and outputs have a low VSWR to minimize environmental effects on frequency distribution through long transmission lines. The HPDA-5 is an enhanced version of the NIST high isolation distribution amplifier.

HPDA-5 OPTIONS

HPDA-5 OEM

The HPDA-5 is available as a HPDA-5 OEM module with one SMA input connector and five SMA output connectors. The power supply requirements are +/- 12.5 VDC, +/- 0.25 A. Board dimensions are 4.8” x 9.5” x 0.65”.

HPDA-5 NM

The HPDA-5 is also available as an HPDA-5 NM. The HPDA-5 NM has an amplifier module with one input and five outputs in a Nuclear Instrumentation Bin Module enclosure. The front panel contains a POWER LED, a STATUS LED, one SMA input connector, and five SMA output connectors. The power supply requirements are +/- (12.5 to 15) VDC, +/-0.25 A.

HIGH PERFORMANCE DISTRIBUTION AMPLIFIER
HPDA-100 Modules

FEATURES

- 80-120 MHz
- Unity gain
- Return loss: -25 dB
- High isolation: 100 dB
- Low phase noise: -158 dBc/Hz @ 10 Hz
  -172 dBc/Hz @ 10 kHz
- Low distortion: -45 dBc
- High output: +15 dBm

APPLICATIONS

- Atomic frequency standards
- Instrumentation
- Reference frequency distribution
- Time scales

DESCRIPTION

The HPDA-100 is a high performance distribution and isolation amplifier. The module has five unity gain outputs with 100 dB of channel-to-channel isolation and 110 dB of reverse isolation. All outputs are AC coupled and the grounds are DC isolated to reduce the effects of ground loops. The input and outputs have a low VSWR to minimize environmental effects on frequency distribution through long transmission lines.

HPDA-100 OPTIONS

HPDA100 OEM

The HPDA-100 is available as an HPDA-100 OEM module with one SMA input connector and five SMA output connectors. The power supply requirements are +18 VDC, 0.25 A. Board dimensions are 4.8” x 6.0” x 0.65”.

HPDA-100 NM

The HPDA-100 NM has an amplifier module with one input and five outputs in a Nuclear Instrumentation Bin Module enclosure. The front panel contains a POWER LED, a STATUS LED, one SMA input connector, and five SMA output connectors. The power supply requirements are +18 VDC, 0.25 A.

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LOW NOISE FREQUENCY MULTIPLIER
FS100-RM

DESCRIPTION

The FS100-RM ultra-low noise frequency synthesizer can be used with state-of-the-art crystal frequency sources without degrading phase noise or environmental stability. The FS100-RM multiplies the input frequency of 5 or 10 MHz and provides outputs at 10, 20, 40, 80 and 100 MHz, while maintaining spurious modulation less than -55 dBc. The FS100-RM is ideal for phase locking 100 MHz crystal sources with 5 or 10 MHz references.

FEATURES

- 5 or 10 MHz input
- Ultra-low phase noise: -143 dBc/Hz @ 1 Hz
  -170 dBc/Hz @ 1 kHz
  -176 dBc/Hz @ 100 kHz
- Very low spurious: -55 dBc

APPLICATIONS

- Frequency multiplication
- Phase noise measurements
- Reference frequency generation
- Telecommunications standards

SPECIFICATIONS

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Output level	+13 dBm input	-	10	-	dBm
Impedance	input output	- -	50 50	- -	Ohms
Return loss	input (S11) output (S22)	- -	-15 -15	- -	dB
Spurious		-	-55	-50	dBc
Harmonic distortion	+10 dBm output	-	-55	-50	dBc
Phase noise referred to input	1 Hz 1 kHz 10 kHz	- - -	-143 -170 -176	-140 -167 -173	dBc/Hz
Temperature-delay coefficient	0 - 50 ºC	-	45	50	ps/ºC

All tests done at +13 dBm input unless otherwise specified.

LOW NOISE FREQUENCY MULTIPLIER, FS020

FEATURES

- User specified input frequency
- Ultra-Low Phase Noise: -143 dBc/Hz @ 1 Hz
  -170 dBc/Hz @ 1 kHz
  -176 dBc/Hz @ 100 kHz
- Very Low Spurious: -50 dBc

APPLICATIONS

- Frequency multiplication
- Phase noise measurements
- Reference frequency generation
- Telecommunications standards

DESCRIPTION

The FS020 ultra-low noise frequency doubler can be used with state-of-the-art crystal frequency sources without degrading phase noise or environmental stability. The FS020 provides double the input frequency while maintaining spurious signal levels below -50 dBc. The FS020 is ideal for phase lock applications, frequency synthesis chains and frequency distribution. FS020 doublers are available at user specified input frequencies from 1 to 500 MHz.

SPECIFICATIONS

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Output level	+13 dBm input	+11	+13	+15	dBm
Impedance	input output	- -	50 50	- -	Ohms
Return loss	input (S11) output (S22)	- -	-15 -15	- -	dB
Spurious		-	-50	-45	dBc
Harmonic distortion	+15 dBm output	-	-50	-45	dBc
Phase noise referred to input	1 Hz 1 kHz 10 kHz	- - -	-143 -170 -176	-140 -167 -174	dBc/Hz
Temperature-delay coefficient	0 - 50 ºC	-	45	50	ps/ºC

All tests done at +13 dBm input unless otherwise specified.

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LOW NOISE FREQUENCY MULTIPLIER, FS040

FEATURES

- User specified input frequency
- Ultra-low phase noise: -143 dBc/Hz @ 1 Hz
  -170 dBc/Hz @ 1 kHz
  -176 dBc/Hz @ 100 kHz
- Very low spurious: -50 dBc

APPLICATIONS

- Frequency multiplication
- Phase noise measurements
- Reference frequency generation
- Telecommunications standards

DESCRIPTION

The FS040 ultra-low noise frequency multiplier can be used with state-of-the-art crystal frequency sources without degrading phase noise or environmental stability. The FS040 provides four times the input frequency while maintaining spurious signal levels below -50 dBc. The FS040 is ideal for phase lock applications, frequency synthesis chains and frequency distribution. FS040 multipliers are available at user specified input frequencies from 1 to 50 MHz with a 10% bandwidth. The FS040 is available in a milled aluminum enclosure with dimensions of 4.0" X 5.1" X 1.1" and SMA connectors. The module requires +12 to +15 VDC at 150 mA.

SPECIFICATIONS

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Output level	+13 dBm input	+11	+13	+15	dBm
Impedance	input output	- -	50 50	- -	Ohms
Return loss	input (S11) output (S22)	- -	-15 -15	- -	dB
Spurious		-	-50	-45	dBc
Harmonic distortion	+15 dBm output	-	-50	-45	dBc
Phase noise referred to input	1 Hz 1 kHz 10 kHz	- - -	-143 -170 -176	-140 -167 -174	dBc/Hz
Temperature-delay coefficient	0-50 °C	-	45	50	ps/°C

All tests done at +13 dBm input unless otherwise specified.

LOW NOISE FREQUENCY MULTIPLIER, FS080

FEATURES

- User specified input frequency
- Ultra-low phase noise: -143 dBc/Hz @ 1 Hz
  -170 dBc/Hz @ 1 kHz
  -176 dBc/Hz @ 100 kHz
- Very low spurious: -55 dBc

APPLICATIONS

- Frequency multiplication
- Phase noise measurements
- Reference frequency generation
- Telecommunications standards

DESCRIPTION

The FS080 ultra-low noise frequency multiplier can be used with state-of-the-art crystal frequency sources without degrading phase noise or environmental stability. The FS080 provides eight times the input frequency while maintaining spurious signal levels below -55 dBc. Outputs at X2, and X4 the input frequencies are available as an option. The FS080 is ideal for phase locking crystal sources with 5 or 10 MHz references. The FS080 is available in a stand-alone enclosure, NIM module or aluminum enclosures.

SPECIFICATIONS

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Output level	+13 dBm input	-	10	-	dBm
Impedance	input output	- -	50 50	-	Ohms
Return loss	input (S11) output (S22)	- -	-15 -15	- -	dB
Spurious		-	-55	-50	dBc
Harmonic distortion	+10 dBm output	-	-55	-50	dBc
Phase noise referred to input	1 Hz 1 kHz 10 kHz	- - -	-143 -170 -176	-140 -167 -173	dBc/Hz
Temperature-delay coefficient	0 - 50 °C	-	45	50	ps/°C

All tests done at +13 dBm input unless otherwise specified.

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100 MHz FREQUENCY SYNTHESIZER, FS100

FEATURES

- 10 MHz input
- Ultra-low phase noise: -143 dBc/Hz @ 1 Hz
  -170 dBc/Hz @ 1 kHz
  -176 dBc/Hz @ 100 kHz
- Very low spurious: -55 dBc

APPLICATIONS

- Frequency multiplication
- Phase noise measurements
- Reference frequency generation
- Telecommunications standards

DESCRIPTION

The FS100 ultra-low noise frequency synthesizer can be used with state-of-the-art crystal frequency sources without degrading phase noise or environmental stability. The FS100 multiplies the input frequency of 10 MHz and provides a 100 MHz output, while maintaining spurious signal levels below -55 dBc. The FS100 is ideal for phase locking 100 MHz crystal sources with 10 MHz references. Other multiplied frequency outputs are available as an option.

SPECIFICATIONS

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Output level	+13 dBm input	-	10	-	dBm
Impedance	input output	- -	50 50	- -	Ohms
Return loss	input (S11) output (S22)	- -	-15 -15	- -	dB
Spurious		-	-55	-50	dBc
Harmonic distortion	+10 dBm output	-	-55	-50	dBc
Phase noise referred to input	1 Hz 1 kHz 10 kHz	- - -	-143 -170 -176	-140 -167 -173	dBc/Hz
Temperature-delay coefficient	0 - 50 ºC	-	45	50	ps/ºC

All tests done at +13 dBm input unless otherwise specified.

POWER AMPLIFIER, PA-100

DESCRIPTION

The PA-100 is a high gain power amplifier in a 2U rack–mount enclosure. The instrument contains three RF power amplifiers with 10 MHz to 200 MHz bandwidth. The amplifiers have +24 dB of gain and a 1 dB compression point of +30 dBm.

FEATURES

- Frequency range: 10 MHz to 200 MHz
- High output power: +30 dBm
- Low VSWR: < 1.5
- High gain: +24 dB
- Low distortion: < -35 dBc @ +27 dBm output

APPLICATIONS

- AO Driver
- General purpose amplifier

SPECIFICATIONS

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Maximum output level	+7 dBm input	-	30	31	dBm
Impedance	input output	- -	50 50	-	Ohms
Return loss	input (S11) @ 100 MHz output (S22) @ 100 MHz	-22 -30	-20 -25	- -	dB
Harmonic distortion @ 10 MHz	+27 dBm output +30 dBm output	-36 -24	-33 -22	- -	dB
Harmonic distortion @ 100 MHz	+27 dBm output +30 dBm output	- -	-34 -24	- -	dB
Harmonic distortion @ 200 MHz	+27 dBm output +30 dBm output	- -	-45 -28	- -	dB

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DISTRIBUTED 10 MHz FREQUENCY REFERENCE, FEL-10

DESCRIPTION

The FEL-10 is a low noise distributed 10 MHz frequency reference. The device can be used to provide a stable and spectrally pure 10 MHz reference. The FEL-10 can be phase locked via a +/- 5 VDC tuning signal or phase locked to an external 10 MHz 1VRMS signal. The unit incorporates a low noise OCXO and the high performance distribution amplifier module, HPDA. Five outputs are available with channel to channel and reverse isolation exceeding 100 dB. The FEL-10 is offered in a stand-alone rack-mount enclosure with SMA connectors. The optional PLL module allows locking to an external 10 MHz source. The PLL module has loss of reference and loss of lock indicators.

FEATURES

- High isolation: > 100 dB
- Low harmonic distortion: -45 dBc
- Low phase noise

APPLICATIONS

- Reference frequency generation
- Earth station references
- Phase noise measurements
- Frequency distribution

SPECIFICATIONS

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Output level		+10	+13	-	dBm
Isolation	output to output output to input	-	100 100	-	dB
Mech. tuning range		-	+/-1 E-6	-	-
Electrical tuning range	+/- 5 VDC	-	+/- 2 E-7	-	-
Aging	after 30 days of operation	-	1 E-9	-	Per day
Tuning port voltage		-	+/- 5	-	VDC
Temperature stability	@ 10 MHz, 0 – 50 C	-	+/-1.5 E-8	-	-
Phase noise L(f)	10 Hz 100 Hz 1 kHz >10 kHz	- - - -	-125 -155 -164 -165	-122 -152 -161 -162	dBc/Hz
Harmonics		-	-45	-40	dBc

LOW NOISE FREQUENCY REFERENCE, LNFR-100

DESCRIPTION

The LNFR-100 is an ultra-low noise frequency reference. The LNFR-100 contains 5 MHz and 100 MHz ultra-low noise ovenized oscillators. The output at 10 MHz is obtained by multiplying the signal from the 5 MHz oscillator. The 100 MHz oscillator is phase locked to the 5 MHz oscillator to provide a lower phase noise signal inside the bandwidth of the phase-locked loop. The device can be used as a low noise source in phase noise measurement systems. Other applications include high stability frequency synthesizers, reference frequency generation and frequency synthesis chains for atomic standards. The LNFR-100 can be phase locked via a +/- 5 VDC tuning signal or with a 5 MHz 1 VRMS signal. This synthesizer is offered in a stand-alone rack-mount package. For frequency synthesis chain applications the synthesizer is available in modular form.

FEATURES

- Low environmental sensitivity
- Ultra-low phase noise
- Very low spurious

APPLICATIONS

- Atomic frequency standards
- Phase noise measurements
- Reference frequency generation
- Telecommunications standard

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SPECIFICATIONS

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Output level		+11	+14	-	dBm
Electrical tuning range	@ 5 MHz	+/- 1 E-6	+/- 1 E-6	-	-
Tuning port voltage		-	+/- 5	-	VDC
Temperature stability	@ 5 MHz, 0 – 50 C	-	-	+/- 5 E-9	-
Phase noise measured at 5 MHz	1 Hz 10 Hz 100 Hz >1 kHz	- - - -	-118 -150 -169 -175	-115 -145 -164 -173	dBc/Hz
Phase noise measured at 10 MHz	1 Hz 10 Hz 100 Hz 1 kHz >10 kHz	- - - - -	-112 -142 -160 -167 -170	-109 -138 -156 -165 -166	dBc/Hz
Phase noise measured at 100 MHz	10 Hz 100 Hz 1 kHz >10 kHz	- - - -	-120 -134 -157 -177	-118 -131 -153 -172	dBc/Hz
Spurious	5, 10 and 100 MHz	-	-	-110	dBc
Harmonics	5, 10 and 100 MHz	-	-40	-	dBc

Option -HS High Stability Oven

A 5 MHz OCXO with a temperature stability of +/-1 E-9 for the temperature range of 10 to 40 °C.

LOW NOISE FREQUENCY REFERENCE, LNFR-100E

DESCRIPTION

The LNFR-100E is a high performance 10 MHz distributed frequency reference. It contains a 5 MHz SC-cut ovenized oscillator, a low noise frequency doubler and a distribution amplifier module. The 10 MHz signal is distributed by the distribution amplifier to provide four 10 MHz outputs on the back panel. Typical cross-channel isolation is 70 dB and reverse isolation is typically greater than 75 dB. The distribution module does not degrade the phase noise performance of the oscillator that is typically –142 dBc/Hz @ Fourier frequency of 10 Hz and –168 dBc/Hz @ Fourier frequency greater than 10 kHz. The LNFR-100E outputs are matched to 50 ohms to obtain better than 25 dB return loss. The LNFR-100E can be phase locked via an electrical tuning port or by providing an external 10 MHz reference.

FEATURES

- Low environmental sensitivity
- Ultra-low phase noise
- Very low spurious

APPLICATIONS

- Earth station frequency reference
- Phase noise measurements
- Reference frequency generation
- Telecommunications standard

SPECIFICATIONS

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Output level	50 ohm load	+11	+14	+15	dBm
Output impedance	return loss @ 10 MHz		-25		dB
Harmonic distortion	50 ohm load		-40	-38	dBc
Isolation	output to output	60	70		dB
Temperature stability	0 - 50 ºC		+/- $5x10^{-9}$		
Mechanical tuning			+/- $1x10^{-6}$		
Electrical Tuning	+/-5VDC		+/- $2x10^{-7}$		
Stability	Allan variance τ=1s		1E-12		
Phase noise @ 10 MHz	1 Hz 10 Hz 100 Hz 1 kHz 10 kHz		-112 -142 -160 -167 -170	-109 -138 -156 -165 -166	dBc/Hz
Spurious		-	-120	-110	dBc

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SPECIFICATIONS

Absolute Maximum Ratings

RF power on tuning port	+20 dBm Maximum
DC Voltage on tuning port	± 0 VDC Maximum
RF Power on outputs	+20 dBm Maximum
DC Voltage on outputs	50 VDC Maximum
Storage Temperature	-10 to +75 ºC
Operation Environment	0 to + 50 ºC

Chassis 2U H, 19 “ W, 16” D

LOW NOISE FREQUENCY REFERENCE, LNFR-400

DESCRIPTION

The LNFR-400 is an ultra-low noise frequency reference. The device can be used as a low noise source in phase noise measurement systems. Other applications include high stability frequency synthesizers, reference frequency generation and frequency synthesis chains for atomic standards. The LNFR-400 contains 5 MHz and 100 MHz ultra-low noise ovenized oscillators. The outputs at 10 MHz, 20 MHz, 40 MHz and 80 MHz are obtained by multiplying the signal from the 5 MHz oscillator. The 100 MHz oscillator is phase locked to the 5 MHz oscillator to provide a lower phase noise signal inside the bandwidth of the phase-locked loop. The output of the 100 MHz oscillator is doubled to obtain 200 MHz and doubled again to obtain 400 MHz. All outputs to the front panel are buffered with low noise isolation amplifiers. The LNFR-400 can be phase locked via a +/- 5 VDC tuning signal or with a 5 MHz 1 VRMS signal. The synthesizer is offered in a stand-alone rack-mount package. For frequency synthesis chain applications the synthesizer is available in modular form.

FEATURES

- External 5 MHz/DC tuning
- Low environmental sensitivity
- Ultra-low phase noise
- Very low spurious: -100 dBc

APPLICATIONS

- Atomic frequency standards
- Phase noise measurements
- Reference frequency generation
- Telecommunications standards

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SPECIFICATIONS

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Output level		+13	+15	-	dBm
Electrical tuning range	@ 5 MHz	+/- 1 E-6	-	-	-
Tuning port voltage		-	+/- 5	-	VDC
Temperature stability	@ 5 MHz, 10 – 40 C	-	+/- 5 E-9	-	-
Phase noise measured at 5 MHz	1 Hz 10 Hz 100 Hz >1 kHz	- - - -	-118 -150 -167 -173	-115 -145 -164 -171	dBc/Hz
Phase noise measured at 10 MHz	1 Hz 10 Hz 100 Hz >1 kHz	- - - -	-114 -142 -160 -168	-111 -138 -156 -166	dBc/Hz
Phase noise measured at 100 MHz	10 Hz 100 Hz 1 kHz >10 kHz	- - - -	-120 -133 -155 -175	-118 -129 -153 -174	dBc/Hz
Phase noise measured at 400 MHz	10 Hz 100 Hz 1 kHz >10 kHz	- - - -	-110 -120 -144 -163	-106 -117 -141 -161	dBc/Hz
Spurious	5, 10 and 100 MHz	-	-	-110	dBc
Harmonics	5, 10 and 100 MHz	-	-40	-35	dBc

OPTIONS

Option -HS High Stability Oven
A 5 MHz OCXO with a temperature stability of +/-1 E-9 for the temperature range of 10 to 40 °C.

Option -20, -40, -80, -200 Additional outputs at the specified frequency in MHz are supplied.

-20 20 MHz output at +13 dBm is provided.
-40 40 MHz output at +13 dBm is provided.
-80 80 MHz output at +13 dBm is provided.
-200 200 MHz output at +13 dBm is provided.

9.192 GHz FREQUENCY SYNTHESIZER, CS-1

DESCRIPTION

The Synthesizer Module is a high stability and high resolution signal source designed to be used in the implementation of a Cesium atomic clock. The CS-1 is provided as two separate modules, the Synthesizer Module and the DC power module. Both modules come in a 2U, 19 inch rack-mount enclosure. All synthesizer functions are accessed from the front panel or a RS232 interface. An external trigger input may be used to synchronize programmable events such as frequency sweeps, phase modulation and amplitude modulation with external events. The synthesizer is implemented with a flexible modular topology. Two ultra-low noise quartz oscillators are part of the multiplication chain from 5 MHz to 100 MHz. Buffered outputs are provided at the front panel for 5 MHz, 10 MHz and 100 MHz. The 100 MHz signal is the highest frequency in the low frequency section of the synthesizer. This 100 MHz signal is distributed using a one input, four output isolation amplifier. One of these 100 MHz signal is used as the reference for a 9.2 GHz DRO. The output of the 9.2 GHz DRO is buffered and used to drive the LO port of a single-sideband mixer. The second 100 MHz signal is used to clock a DDS synthesizer module. The DDS synthesizer generates an IF signal with 48 bit resolution and complete modulation capabilities. The DDS synthesizer output drives the IF port of the single-sideband mixer. The lower sideband of the mixer is selected as the output generating the 9.XXX GHz output signal. The amplitude of the 9.XXX GHz output is controlled with 12 bits of resolution and an internal relay may be used to turn off the RF signal.

FEATURES

- Output signals:
  5 MHz, 10 MHz, 100 MHz, 7 MHz, 9.2 GHz, 9.192 GHz
- Synchronization capabilities with external events:
  Amplitude modulation
  Frequency sweeps
  Phase modulation
- Low phase noise
- State machine operation

APPLICATIONS

- Atomic frequency standards
- Atomic time scales
- Reference frequency generation

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SPECIFICATIONS

PARAMETER	CONDITIONS	TYP	UNITS
Frequency stability $\sigma_y(\tau)$ Ref. 5 MHz, +13 dBm Pair measurement	averaging time 1 s 10 s 100 s 1000 s 100000 s 1000000 s	 $1 \cdot 10^{-13}$ $1 \cdot 10^{-14}$ $1 \cdot 10^{-15}$ $2 \cdot 10^{-16}$ $2 \cdot 10^{-17}$ $2 \cdot 10^{-17}$	-
Phase noise L(f) Carrier 9.192 GHz Pair measurement	offset frequency 10 Hz 100 Hz 1 kHz 10 kHz 100 kHz 1 MHz	 -80 -93 -107 -120 -120 -130	dBc/Hz
Phase noise L(f) Carrier 100 MHz	offset frequency 10 Hz 100 Hz 1 kHz >10 kHz	 -120 -133 -155 -175	dBc/Hz
Phase noise L(f) Carrier 10 MHz	offset frequency 1 Hz 10 Hz 100 Hz >1 kHz	 -114 -142 -160 -168	dBc/Hz
Phase noise L(f) Carrier 5 MHz	offset frequency 1 Hz 10 Hz 100 Hz >1 kHz	 -118 -150 -167 -173	dBc/Hz
Temperature coefficient @ 9.192 GHz		0.5	ps/K

External reference
5.0 MHz ± $2.0 \cdot 10^{-8}$
+7 dBm to +15 dBm

Rack-mount enclosure
Size: 3.5" X 16" X 19"
Weight: 20 lbs

HIGH RESOLUTION PHASE AND FREQUENCY OFFSET GENERATOR

US Patent 6,278,330

HROG-5

DESCRIPTION

The HROG-5 is a high-resolution phase and frequency offset generator. The phase and frequency of the output signals are adjustable with respect to a 5 MHz user supplied reference. The output phase resolution of the generator is $2\pi/2^{32}$ radians or an output time step resolution of 0.3 fs. The output frequency resolution is 5×10^{-19}. Both phase and frequency steps are phase continuous. The instrument provides two sine-wave outputs and two pulse outputs. The sine-wave outputs are buffered to provide greater than 80 dB of port to port and reverse isolation. The outputs are at a level of +16 dBm. The pulse outputs are derived from the sine wave outputs by dividing by a factor of 5.0E6. The pulse outputs can be synchronized to an external reference pulse to within 200 ns. All instrument functions are displayed and controlled via the front panel LCD display and keypad. Remote control of the instrument is possible through RS-232 communications.

FEATURES

- High isolation: > 100 dB
- High phase resolution: 5 fs
- Low harmonic distortion: -45 dBc
- Low phase noise (1 kHz) : -165 dBc/Hz

APPLICATIONS

- Atomic frequency standards
- Clock synchronization
- Time-scales
- Clock steering
- Frequency offset generation

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SPECIFICATIONS

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Phase resolution		-	$2\pi / 2^{32}$	-	radians
Phase offset range		-	infinite	-	-
Time offset resolution	5 MHz external reference	-	0.3	-	fs
Frequency resolution		-	5 E-19	-	-
Frequency tuning range		-	+/- 2 E-7	-	-
Mech. tuning range		-	+/-1 E-6	-	-
Int. oscillator aging	after 30 days of operation	-	1 E-10	-	Per day
5 MHz output level	50 ohm load	+10	+13	+17	dBm
1PPS output level	50 ohm load	2.2	2.4	2.6	V
Output isolation	Channel-to-channel reverse	- -	80 80	- -	dB
Phase noise L(f) Note: lower phase noise is available.	10 Hz 100 Hz 1 kHz >10 kHz	- - - -	-135 -160 -165 -165	-132 -157 -162 -163	dBc/Hz
Allan deviation $s_y(t)$	Δf = 1.0 E-12 1 s 10 s 100 s 1000 s	 - - - -	 2.1 E-13 3.2 E-14 2.0 E-14 9 E-15	 - - - -	-
Allan deviation $s_y(t)$	Δf = 0 1 s 10 s 100 s	 - - -	 8 E-14 4 E-14 1 E-14	 - - -	-
Spurious		-	-110	-100	dBc
Harmonics		-	-45	-40	dBc

External reference: 5.0 MHz ± 2.0 E-8, +10 dBm to +15 dBm
External 1PPS: 800 ns min. pulse width, TTL compatible levels
AC power: 110–120 / 220–240VAC

Rack-mount enclosure
Size: 3.5” X 16” X 19”
Weight: 20 lbs

HIGH RESOLUTION PHASE AND FREQUENCY OFFSET GENERATOR

US Patent 6,278,330

HROG-10

DESCRIPTION

The HROG-10 is a high-resolution phase and frequency offset generator. The phase and frequency of the output signals are adjustable with respect to a 10 MHz user supplied reference. The output phase resolution of the generator is $2\pi/2^{32}$ radians or an output time step resolution of 0.2 fs. The output frequency resolution is 5×10^{-19}. Both phase and frequency steps are phase continuous. The instrument provides two sine-wave outputs and two pulse outputs. The sine-wave outputs are buffered to provide greater than 80 dB of port-to-port and reverse isolation. The outputs are at a level of +13 dBm. The pulse outputs are derived from the sine-wave outputs by dividing by a factor of 10.0E6. The pulse outputs can be synchronized to an external reference pulse to within 100 ns. All instrument functions are displayed and controlled via the front panel LCD display and keypad. Remote control of the instrument is possible through RS-232 communications.

FEATURES

- High isolation: > 80 dB
- High phase resolution: 5 fs
- Low harmonic distortion: -45 dBc
- Low phase noise (1 kHz) : -165 dBc/Hz

APPLICATIONS

- Atomic frequency standards
- Clock synchronization
- Time-scales
- Clock steering
- Frequency offset generation

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SPECIFICATIONS

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Phase resolution		-	$2\pi(2^{-32})$	-	radians
Phase offset range		-	infinite	-	-
Time offset resolution	10 MHz external reference	-	0.15	-	fs
Frequency resolution		-	5 E-19	-	-
Frequency tuning range		-	+/- 1 E-7	-	-
Mech. tuning range		-	+/-1 E-6	-	-
Int. oscillator aging	after 30 days of operation	-	5 E-10	-	Per day
10 MHz output level	50 Ohm load	+10	+13	+17	dBm
1PPS output level	50 Ohm load	2.2	2.4	2.6	V
Output Isolation	Channel-to-channel reverse	- -	80 80	- -	dB
Phase noise $\mathcal{L}(f)$ Note: lower phase noise is available.	10 Hz 100 Hz 1 kHz >10 kHz	- - - -	-130 -155 -165 -165	-127 -152 -162 -163	dBc/Hz
Allan deviation $\sigma_y(\tau)$	Δf = 1.0 E-12 1 s 10 s 100 s 1000 s	 - - - -	 2.1 E-13 3.2 E-14 2.0 E-14 9 E-15	 - - - -	
Allan deviation $\sigma_y(\tau)$	Δf = 0 1 s 10 s 100 s	 - - -	 1 E-13 2 E-14 2 E-15	 - - -	
Spurious		-	-110	-100	dBc
Harmonics		-	-45	-40	dBc

External reference: 10.0 MHz ± 2.0 E-8, +10 dBm to +15 dBm
External 1PPS: 400 ns min. pulse width, TTL compatible levels
AC power: 110–120/ 220–240VAC

Rack-mount enclosure
Size: 3.5” X 16” X 19”
Weight: 20 lbs

LOW NOISE FREQUENCY SYNTHESIZER, LNFS-100

DESCRIPTION

The LNFS-100 is a low noise synthesizer with an output frequency range of 1μHz to 120 MHz. The synthesizer has 48 bit frequency resolution, 14 bit phase resolution and 12 bit amplitude control. The low noise internal time base can be phase-locked to an external 5 or 10 MHz signal for long term stability and accuracy. The synthesizer can be used as a frequency source for instrumentation, microwave synthesis, phase noise characterization, radar synthesizers and telecommunication clock systems. The LNFS-100 has AM, FM, PM, FSK, ASK, BPSK and QPSK modulation capabilities. The synthesizer is available in a stand alone enclosure or as a NIM module. Model LNFS-100-RM is the stand alone version in a 2U rack-mount enclosure with LCD display and keypad. Remote control of the instrument is available through a RS-232 interface. This unit may be ordered with up to three independent synthesizers locked to the internal time base.

FEATURES

- Frequency range: 1μHz - 120 MHz
- Amplitude range: 5 mV - 5 V_{p-p} into 50 Ω
- Frequency resolution: 1 μHz
- Phase resolution: 0.38 mRadians
- Low phase noise : 5 MHz, +10 dBm output
  -140 dBc/Hz @ 100 Hz
  -160 dBc/Hz @ 1 kHz

APPLICATIONS

- Instrumentation
- Microwave synthesis
- Phase noise characterization
- Radar synthesizers
- Telecom clock generation

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SPECIFICATIONS

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Phase resolution		-	0.022	-	degrees
Phase offset range		-	+/- 360	-	degrees
Amplitude resolution		-	0.01	-	Vrms
Frequency resolution		-	1 E-6	-	Hz
Frequency tuning range		-	1 – 120	-	MHz
Mech. tuning range		-	+/-1 E-6	-	-
Int. oscillator aging	after 30 days of operation	-	5 E-10	-	Per day
Max sine output level	50 Ohm Load, accuracy +/-2	+14	+15	+16	dBm
Pulse output level	50 Ohm Load	+9	+10	+11	dBm
Output isolation	channel to channel reverse	- -	80 80	- -	dB
Phase noise L(f) 5 MHz output, +15 dBm	10 Hz 100 Hz 1 kHz >10 kHz	- - - -	-135 -147 -154 -160	-133 -145 -152 -155	dBc/Hz
Phase noise L(f) 10 MHz output, +15 dBm	10 Hz 100 Hz 1 kHz >10 kHz	- - - -	-130 -142 -150 -155	-127 -140 -147 -153	dBc/Hz
Allan deviation $s_y(t)$ Locked to ext reference	f = 5E6 1 s 10 s 100 s	 - - -	 2.1 E-13 3.2 E-14 2.0 E-14	 - - -	
Allan deviation $s_y(t)$ Locked to ext reference	f = 10E6 1 s 10 s 100 s	 - - -	 3 E-13 4 E-14 6 E-15	 - - -	
Spurious		-100	-50	-45	dBc
Harmonics		-60	-45	-32	dBc

External Reference	10.0 MHz ± 2.0 E-8	+10 dBm to +15 dBm
DC Tuning Voltage	+/- 5VDC	
External Trigger	400 ns min. pulse width	TTL Compatible Levels
AC Power	110 - 120/ 220 - 240VAC	

Rack-mount Enclosure
Size: 3.5” X 16” X 19”
Weight: 20 lbs

LOW NOISE FREQUENCY SYNTHESIZER, LNFS-400

DESCRIPTION

The LNFS-400 is a versatile low noise synthesizer with an output frequency range of 1 to 400 MHz. The instrument has 48 bit frequency resolution, 14 bit phase resolution and a low noise internal time base that can be phase-locked to an external 5 or 10 MHz signal for long term stability. Applications include frequency generation for instrumentation, microwave synthesis, phase noise characterization, radar synthesizers and telecommunication clock generators. The LNFS-400 has FSK and PSK modulation capabilities. The synthesizer is available in a stand alone enclosure or as a module. Model LNFS-400-RM is the stand alone version in a 2U rack-mount enclosure with LCD display and keypad. Remote control of the instrument is available through a RS-232 interface. This unit may be ordered with up to three independent synthesizers locked to the internal time base.

FEATURES

- Frequency range 1 - 400 MHz
- Frequency Resolution: 0.2 Hz
- Phase resolution: 0.38 mRadians
- Low phase noise : 180 MHz output
  -130 dBc/Hz @ 1 kHz
  -140 dBc/Hz @ 100 kHz

APPLICATIONS

- Instrumentation
- Microwave synthesis
- Phase noise characterization
- Radar synthesizers
- Telecom clock generation

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SPECIFICATIONS

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Phase resolution		-	0.022	-	degrees
Phase offset range		-	+/- 360	-	degrees
Amplitude resolution		-	1.0	-	dBm
Frequency resolution		-	0.233	-	Hz
Frequency tuning range		-	1 – 400	-	MHz
Mech. tuning range		-	+/-1 E-6	-	-
Int. oscillator aging	after 30 days of operation	-	1 E-6	-	Per year
Max sine output level	50 ohm load, accuracy +/-2dB	+14	+15	+16	dBm
Output isolation		-	60	-	dB
Phase noise $\mathcal{L}(f)$ 10 MHz output, +13 dBm	10 Hz 100 Hz 1 kHz >10 kHz	- - - -	-130 -135 -135 -145	-125 -130 -130 -140	dBc/Hz
Allan deviation $\sigma_y(\tau)$ Locked to ext reference	f = 5E6 1 s 10 s 100 s	 - - -	 2.0 E-12 3.0 E-13 3.0 E-14	 4.0 E-12 4.0 E-13 5.0E-14	
Allan deviation $\sigma_y(\tau)$ Locked to ext reference	f = 10E6 1 s 10 s 100 s	 - - -	 2.0 E-12 3.0 E-13 3.0 E-14	 3.0 E-13 4.0 E-13 5.0E-14	
Spurious	+13 dBm output level	-65	-50	-45	dBc
Harmonics	+13 dBm output level	-60	-40	-30	dBc

External reference	10.0 MHz ± 2.0 E-8	+10 dBm to +15 dBm
DC tuning voltage	+/- 5VDC	
External trigger	400ns min. pulse width	TTL compatible levels
AC power	110–120/ 220–240VAC	

Rack-mount enclosure
Size: 3.5” X 16” X 19”
Weight: 20 lbs

PULSE GENERATOR, PPS-2

FEATURES

- External sync
- High stability
- Low input VSWR
- Low temperature coefficient: 3 ps/ºC
- 50 ohm output: 2 Vp-p

APPLICATIONS

- Reference clock distribution
- Time synchronization
- 1 PPS generation

DESCRIPTION

The PPS-2 pulse generator is used to generate one pulse per second signals from a sine-wave input signal. The input can be a 1 MHz, 5 MHz or 10 MHz signal. The pulse-per-second (pps) output has a variable pulse width. The input frequency selection and pulse width selections are configured via jumper settings. The output pps can synchronize with an external event. The synchronization is good to +/- ½ of the input clock cycle. The outputs are designed to drive low impedance loads and long 50 or 75-ohm cables. The channel-to-channel delay differences are less than 1 ns. The instrument is available in a 3.5" X 8.4" X 12 " enclosure. The unit will operate on 110/220 VAC.

SPECIFICATIONS

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Rise time	10 - 90 %	-	3	4	ns
Fall time	10 - 90 %	-	3	4	ns
Differential delay	channel - channel	-	200	500	ps
Impedance	input output	- -	50 10	- -	Ohms
Return loss	Input (S11)	-	-35	-25	dB
High level Low level	50 ohm load 50 ohm load	2 -	2.4 0.4	- 0.5	V V
Input signal level	1 MHz, 5 MHz and 10 MHz	-3	+7	+13	dBm
External Sync. error	1 MHz 5 MHz 10 MHz	- - -	+/- 500 +/- 100 +/- 50	- - -	ns
Temperature-delay coefficient	0 - 50 ºC	-	3	5	ps/ºC

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6.834 GHz FREQUENCY SYNTHESIZER, RB-1

DESCRIPTION

The 6.834 GHz Synthesizer, RB-1 is a high stability and high resolution signal source designed to be used in the implementation of a Rubidium atomic clock. The RB-1 is provided in two separate enclosures, the Synthesizer Module and the DC Module, both in a 2U, 19 inch rack-mount enclosure. All synthesizer functions are accessed from the front panel or a RS232 interface. An external trigger input may be used to synchronize programmable events such as frequency sweeps, phase modulation and amplitude modulation with external events. The synthesizer is implemented with a flexible modular topology. Two ultra-low noise quartz oscillators are part of the multiplication chain from 5 MHz to 100 MHz. Buffered outputs are provided at the front panel for 5 MHz, 10 MHz and 100 MHz. The 100 MHz signal is the highest frequency in the low frequency section of the synthesizer. This 100 MHz signal is distributed using a one input, four output isolation amplifier. One of these 100 MHz signals is used as the reference for a 6.8 GHz DRO. The output of the 6.8 GHz DRO is buffered and used to drive the LO port of a single-sideband mixer. The second 100 MHz signal is used to generate the 200 MHz clock for the DDS synthesizer module. The DDS synthesizer generates a 34.xx MHz signal with 48 bit resolution and complete modulation capabilities. The DDS synthesizer output drives the IF port of the single-sideband mixer. The upper sideband of the mixer is selected as the output generating the 6.834 GHz output signal. The amplitude of the 6.834 GHz output is controlled with 12 bits of resolution and an internal relay may be used to turn off the RF signal.

FEATURES

- Output signals: 5 MHz, 10 MHz, 100 MHz, 34 MHz, 6.8 GHz, 6.834 GHz.
- Synchronization capabilities with external events:
  - Frequency sweeps
  - Phase modulation
  - Amplitude modulation
- Low phase noise

APPLICATIONS

- Atomic frequency standards
- Atomic time scales
- Reference frequency generation

SPECIFICATIONS

PARAMETER	CONDITIONS	TYP	UNITS
	averaging time		
Frequency stability $s_y(t)$	1 s	$1 \cdot 10^{-13}$	-
	10 s	$1 \cdot 10^{-14}$	
Ref. 5 MHz, +13 dBm	100 s	$1 \cdot 10^{-15}$	
Pair measurement	1000 s	$2 \cdot 10^{-16}$	
	100000 s	$2 \cdot 10^{-17}$	
	1000000 s	$2 \cdot 10^{-17}$	
	offset frequency		
Phase noise L(f)	10 Hz	-82	
	100 Hz	-94	
Carrier 6.834 GHz	1 kHz	-112	dBc/Hz
Pair measurement	10 kHz	-120	
	100 kHz	-120	
	1 MHz	-130	
	offset frequency		
Phase noise L(f)			
	10 Hz	-122	dBc/Hz
Carrier 100 MHz	100 Hz	-132	
	1 kHz	-159	
	>10 kHz	-174	
	offset frequency		
Phase noise L(f)			
	1 Hz	-112	dBc/Hz
Carrier 10 MHz	10 Hz	-142	
	100 Hz	-160	
	>1 kHz	-167	
	offset frequency		
Phase noise L(f)			
	1 Hz	-118	dBc/Hz
Carrier 5 MHz	10 Hz	-150	
	100 Hz	-167	
	>1 kHz	-173	
Temperature coefficient		0.5	ps/K
@ 6.834 GHz			

External reference
5.0 MHz ± $2.0 \cdot 10^{-8}$
+7 dBm to +15 dBm

Rack-mount enclosure
Size: 3.5” X 16” X 19”
Weight: 20 lbs

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RF POWER METER

DESCRIPTION

The RFPWR is a battery powered hand-held RF Power Meter. The RFPWR does not require an extra sensor head. It can be used to measure power from –25 dBm to + 25 dBm in a frequency range from 1 MHz to 2 GHz. The RFPWR can provide absolute power measurements as well as relative power measurements. All functions are controlled with a multifunctional button, labeled ON/OFF. The RFPWR can be calibrated using a potentiometer accessible with a small screwdriver on the back of the RFPWR.

FEATURES

- RF POWER range: -25 TO +25 dBm
- Frequency range: 1MHz to 2GHz
- Accuracy: ± 0.5 dB from 1MHz to 1GHz
  ± 1.0 dB from 1GHz to 2GHz
- Absolute and relative RF power measurements
- Calibration option

APPLICATIONS

- Instant signal integrity verification
- Production line testing
- Research and development

AM / PM NOISE MEASUREMENT SYSTEM
NMS

FEATURES

- Easy to use
- Automated AM/PM noise measurements
- Measurement range: 1 MHz to 45 GHz
- Low system residual noise
- Flexible modular design
- Network ready
- Remote measurements capability

APPLICATIONS

- AM/PM noise testing
- Automated production line testing
- Characterization of ultra low noise devices
- Research and development

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DESCRIPTION

The Noise Measurement System product line is a modular instrument that may be customized to implement a versatile dual-channel noise measurement system. The measurement system may be used to make both AM and PM noise measurements on signals in the frequency range of 1 MHz to 45 GHz. Custom detector modules may be added to extend the carrier frequency measurement range. The measurement system is composed of modules that plug into the measurement system mainframe. The mainframe dimensions are 5U X 19" X 16". The mainframe is included with the purchase of a Noise Measurement System Controller (NMSC).

There are two standard measurement system controllers. The NMSC-1 has a spectral analysis capability from DC to 1 MHz. The NMSC-2 extends the spectral analysis frequency range to 10 MHz and can be upgraded to provide spectral analysis from DC to 40 MHz. The NMSC modules contain dual-channel spectrum analysis allowing the measurement of signals that are buried in the system noise floor. The front panel has a 6.4 inch, color touch-screen display. An external keyboard, monitor and printer can also be connected to the controller. Remote measurements or monitoring are possible using an ethernet connection.

There are six slots available on the noise measurement crate for the various measurement modules. Two standard noise detector modules are currently offered that cover the frequency range of 2 MHz to 18 GHz. The ND-1 covers the frequency range of 2 MHz to 1 GHz. The ND-3 module covers the frequency range of 1 GHz to 18 GHz. Custom modules may be ordered to extend the frequency range or implement special measurement topologies. All the noise detector modules are designed to facilitate the measurement of sources as well as passive and active components. A phase locked loop with programmable parameters is included with the noise detectors to facilitate the measurement of noise in signal sources. The PLL parameters can be adjusted so that a wide range of sources can be measured. Noise in amplifiers, multipliers, mixers and other active and passive components can be measured easily with the addition of one of the programmable delay line modules.

Calibration of the Noise Measurement System can be accomplished easily using a noise source module, NS-NM or a tone calibration module, TC-NM. The system can also be calibrated by using the traditional beat-note calibration method. Calibrated noise source modules and tone calibration modules can be ordered for any frequency range of interest.

SPECIFICATIONS

Power supply: 110 VAC, 3A, 60 Hz
220 VAC, 2A, 50 Hz
Operating temperature: 10 to 40 degrees C
Dimensions: 5U X 19" X 16"
Empty weight: 25 lb
Full weight: 50 lb

NOISE MEASUREMENT SYSTEM CONTROLLER, NMSC-1

FEATURES

- Dual channel spectrum analysis
- Easy to use automation software
- Color flat panel display with touchscreen
- WLAN remote measurements
- Flexible software platform

APPLICATIONS

- AM/PM noise measurements
- Controller for the NMS
- Spectrum analysis
- Automation of test equipment

DESCRIPTION

The noise measurement system controller NMSC-1 is provided with the NMS mainframe. The NMSC-1 controls all the measurement modules that are plugged in to the mainframe and includes a 1 MHz dual channel FFT spectrum analyzer. The controller has a bright 6.4 inch color flat panel display. All functions of the measurement system are available through a touch screen on the display. A keyboard and larger display monitor can also be connected to the supplied SVGA and PS/2 connector. The NMSC-1 comes standard with an Ethernet port, RS-232, and USB. Remote control of measurements and display of data is available with an optional WLAN adapter. The measurement system software has been designed to hide the complexity of noise analysis and provide an intuitive user friendly interface. Access and control to all measurement system settings is provided for the experienced user through lower level menus.

The NMSC-1 may be used to control the following modules.

Noise detector modules: ND-1NM, ND-3NM
Delay line modules: DL-1, DL-2
Frequency synthesizer: LNFS-100

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NOISE MEASUREMENT SYSTEM CONTROLLER, NMSC-2

FEATURES

- Dual channel spectrum analysis
- Easy to use automation software
- Color flat panel display with touchscreen
- WLAN remote measurements
- Flexible software platform

APPLICATIONS

- AM/PM noise measurements
- Controller for the NMS
- Spectrum analysis
- Automation of test equipment

DESCRIPTION

The noise measurement system controller NMSC-2 is provided with the NMS mainframe. The NMSC-2 controls all the measurement modules that are plugged in to the mainframe and includes a 10 MHz dual channel FFT spectrum analyzer. The controller has a bright 6.4 inch color flat panel display. All functions of the measurement system are available through a touch screen on the display. A keyboard and larger display monitor can also be connected to the supplied SVGA and PS/2 connector. The NMSC-2 comes standard with an Ethernet port, RS-232, and USB. Remote control of measurements and display of data is available with an optional WLAN adapter. The measurement system software has been designed to hide the complexity of noise analysis and provide an intuitive user friendly interface. Access and control to all measurement system settings is provided for the experienced user through lower level menus.

The NMSC-2 may be used to control the following modules.

Noise detector modules: ND-1NM, ND-3NM
Delay line modules: DL-1, DL-2
Frequency synthesizer:: LNFS-100

Option -01: FFT Spectrum Analysis DC-40 MHz

NOISE DETECTOR, ND-1-NM

FEATURES

- Ultra-low system noise floor
- RF bandwidth: 2 MHz to 1 GHz
- Integrated PLL and calibration port
- Integrated RF level meter

APPLICATIONS

- AM/PM noise measurements
- Characterization of components

DESCRIPTION

Model ND-1NM is a noise detector module that may be used to measure AM or PM noise. The module has a proprietary noise detector that can be used to make very high-resolution single channel or dual-channel measurements. Dual-channel noise analysis will allow an effective reduction of at least 10 dB and up to 20 dB from the system noise floor. RF level measurements are made on both the RF and LO inputs. The low noise IF amplifier has variable gain and bandwidth settings to accommodate different measurement requirements and a calibration input is available for automatic gain calibration. The ND-1NM also includes an adjustable bandwidth phase-lock loop that can be used when measuring oscillators to lock the reference and device under test.

The ND-1NM plugs into the NMS mainframe and requires one of the Noise Measurement System Controllers. The NMSC-1 provides Fourier noise analysis from DC to 1 MHz from the carrier. The NMSC-2 extends the Fourier frequency analysis range to 10 MHz. The ND-1NM uses one slot of the system mainframe.

Option A: 1-500 MHz Mixer

For Medium Level Detector option (+10 dBm to +17 dBm) add -M to the part number.

SPECIFICATIONS

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
RF measurement range	carrier level + 7 to + 15 dBm	-	2 - 1000	-	MHz
Signal level measurement range		-	-25 to +25	-	dBm
IF bandwidth	low high	- -	DC - 400 0.001 - 1	- -	kHz MHz
IF gain		- - -	+26 +46 +66	- - -	dB
PLL tuning bandwidth	carrier level + 7 dBm to + 17 dBm	-	0.1 - 100	-	Hz
System residual PM noise @ 5 MHz, +13 dBm carrier	fourier frequency 1 Hz 10 Hz 100 Hz 1 kHz 10 kHz 100 kHz	 - - - - - -	 -150 -160 -170 -175 -178 -178	 -145 -155 -165 -171 -175 -175	dBc/Hz

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NOISE DETECTOR, ND-3-NM

FEATURES

- Ultra-low system noise floor
- RF bandwidth: 1 GHz to 18 GHz
- Integrated PLL and calibration port
- External mixer input

APPLICATIONS

- AM/PM noise measurements
- Characterization of components

DESCRIPTION

Model ND-3 is a detector module that may be used to measure AM or PM noise. The module has a noise detector that can be used to make very high-resolution single channel measurements. Two modules can be combined to create a dual-channel measurement system. A dual-channel system with cross-correlation noise analysis can allow an effective reduction of at least 10 – 20 dB from the system noise floor. The IF amplifier has variable gain and bandwidth settings. The IF amplifier input can be switched to the front panel to allow connection of an external mixer. A calibration input is available for gain calibration. The ND-3 includes an adjustable bandwidth phase-lock loop that can be used when measuring oscillators to lock the reference and device under test.

The ND-3NM plugs into the NMS mainframe and requires one of the Noise Measurement System Controllers. The NMSC-1 provides Fourier noise analysis from DC to 1 MHz from the carrier. The NMSC-2 extends the Fourier frequency analysis range up to 40 MHz. The ND-3NM uses one slot of the system mainframe.

Option A: 1-45 GHz mixer

Option B: 1-26 GHz mixer

For Medium Level Detector option (+10 dBm to +20 dBm) add -M to the part number.
For High Level Detector option (+15 dBm to +27 dBm) add -H to the part number.

SPECIFICATIONS

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
RF measurement range	carrier level + 7 to + 17 dBm	-	1 - 18	-	GHz
IF bandwidth	low high	- -	DC - 1 0.001 - 40	- -	MHz MHz
IF gain		- - -	+26 +46 +60	- - -	dB
PLL tuning bandwidth	carrier + 7 dBm to + 17 dBm	-	0.01 - 100	-	kHz
System residual PM noise @ 10 GHz, +13 dBm carrier	Fourier frequency 1 Hz 10 Hz 100 Hz 1 kHz 10 kHz 100 kHz 1 MHz	 - - - - - - -	 -130 -140 -150 -160 -168 -170 -170	 -127 -137 -147 -157 -165 -167 -167	dBc/Hz

NOISE SOURCE, NS-NM

FEATURES

- Stable Gaussian noise generator
- Noise bandwidth up to 10%
- Noise flatness < 1 dB
- Low insertion loss

APPLICATIONS

- AM/PM noise measurements
- Characterization of components

DESCRIPTION

Model NS-NM is a gaussian noise source module that may be used to calibrate the AM and PM noise measurement system. The gaussian noise source is typically bandwidth limited to 10% of the carrier frequency of interest and is summed with the RF carrier when calibrating the measurement system. Once calibration is complete, the noise source can be turned off and the AM or PM noise measurement can be completed without disconnecting any of the signals. The noise source calibration certificate may be obtained from SDI or at NIST.

The NS-NM plugs into the NMS mainframe. The noise source can be turned on or off manually or under control of the Noise Measurement System Controller. The NS-NM uses one slot of the system mainframe.

SPECIFICATIONS

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Center frequency	must be specified upon order placement	1	-	45000	MHz
Calibrated noise bandwidth	BW of center frequency	-	10	-	%
Noise Level	low high	- -	-120 -100	- -	dBVrms/rtHz
Noise flatness	+/- 1 MHz +/- 10 MHz	- -	0.5 1.0	- -	dB
Insertion loss		-	1.0	-	dB

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DELAY LINE, DL-1

DESCRIPTION

The DL-1 is a delay line unit that can be used to insert up to 128 ns of time delay. Calibrated transmission lines are switched in and out to adjust the delay from input to output. An adjustable and motorized line stretcher is used for continuous delay adjustment with a range of 0 to 500 ps. The unit has an additional input port that bypasses the long coaxial delay sections for better VSWR performance at high frequencies where long delays are not needed. All delay line unit functions are accessible from the front panel. The unit is also supplied with a RS-232 interface for remote control and automation. This unit can operate as a stand-alone unit or may be used with the NMS series of measurement modules.

FEATURES

- Continuous fine delay control:
  0 - 500 ps
- 9 Insertable delays (ns):
  64, 32, 16, 8, 4, 2, 1, 0.5

APPLICATIONS

- AM/PM noise measurements
- Delay-line method measurements

SPECIFICATIONS

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Operational bandwidth	-	-	DC - 4	-	GHz
Adjustable delay range	1N1 1N2	- -	0 - 128 0 - 2	- -	ns
VSWR	-	-	< 1.5	-	-
Insertion loss	100 MHz	-	< 4	-	dB

DELAY LINE, DL-2

DESCRIPTION

The DL-2 is a delay line unit that may contain up to two line stretchers each providing 250 ps of time delay. The line stretchers have independent inputs and outputs so that they may be used separately or daisy-chained to provide up to 500 ps of delay. Each line stretcher is motorized and can be used for continuous delay adjustment. All delay line unit functions are accessible from the front panel. The unit is also supplied with a RS-232 interface for remote control and automation. This unit can operate as a stand-alone unit or may be used with the NMS series of measurement modules.

FEATURES

- Continuous fine delay control: 0 - 500 ps
- Low insertion loss: 1 dB

APPLICATIONS

- AM/PM noise measurements
- Delay line method measurements

SPECIFICATIONS

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Operational bandwidth	-	-	DC - 18	-	GHz
Adjustable delay range	-	-	0 - 250	-	ps
VSWR	-	-	< 1.5	-	-
Insertion loss	10 GHz	-	< 1	-	dB

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Ordering information

To order any product, obtain pricing information or for additional technical information, please contact SpectraDynamics, Inc. (SDI). Purchase orders may be faxed to SDI at (303) 604-6088. The original copy of the purchase order should be mailed to SDI for confirmation. If you are a new customer, we ask that you include a copy of your credit references when initially placing your order. Standard terms are net 30. Payment may be made by check payable to SpectraDynamics, Inc. We also accept VISA, MasterCard, bank draft and money orders. Delivery is FOB Louisville, Colorado.

Warranty

All SpectraDynamics, Inc. products are warranted to be free of defects under normal operating conditions, as specified, for one year from date of original shipment from SDI. SDI's obligation and liability under this warranty is expressly limited to repairing or replacing, at SDI's option, any product not meeting the said specifications. This warranty shall be in effect for one (1) year from the date a product is sold by SDI. SpectraDynamics makes no other warranty, express or implied, and makes no warranty of the fitness for any particular purpose. SDI's obligation under this warranty shall not include any transportation charges or costs of installation or any liability for direct, indirect, or consequential damages or delay. Any improper use, operation beyond capacity, substitution of parts not approved by SDI, or any alteration or repair by others in such manner as in SDI's reasonable judgment affects the product materially and adversely shall void this warranty. No employee or representative of SDI is authorized to change this warranty in any way or grant any other warranty. Products manufactured or developed by SDI are not licensed for use in any nuclear (other than for time keeping), aviation, mass transit, or medical application or in any other inherently dangerous application. SDI shall not have any liability arising from any inherently dangerous uses by any customer or end-user in any such application.

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